

## CLAIMS

1. A device for detecting at least a non-authorized material in a zone with protected access, the device being characterized by the fact that it comprises in  
5 combination:

- a supporting base (100) designed to receive a single foot wearing a shoe, of an individual to be inspected;
- detector means (430, 450, 460) adapted to detect a  
10 target material by employing at least one magnetic resonance technique to detect said non-authorized material and associated with the support base (100); and
- position-identifying means (400) on the support base (100) suitable for imposing accurate positioning of  
15 the foot of the individual being inspected relative to the detector means.

2. A device according to claim 1, characterized by the fact that the at least one magnetic resonance technique  
20 employed is Electronic Spin Resonance or is Nuclear Magnetic Resonance or is Nuclear Quadrupole Resonance or are Electronic Spin Resonance and Nuclear Magnetic Resonance, or are Electronic Spin Resonance and Nuclear Quadrupole Resonance, or are Nuclear Magnetic Resonance  
25 and Nuclear Quadrupole Resonance, or are Electronic Spin Resonance, Nuclear Magnetic Resonance, and Nuclear Quadrupole Resonance.

3. A device according to claim 1 or 2, characterized by  
30 the fact that the supporting base (100) comprises a block in the form of a step with the position-identifying means (400) on its top surface (102).

4. A device according to claim 1 or 2 or 3, characterized  
35 by the fact that the detector means comprise two Helmholtz coils (450, 460), assembled on the two sides of the position-identifying means (400), the winding planes

of said coils being positioned at a reciprocal distance equals to the mean radius of said coils.

5 5. A device according to claim 3, characterized by the fact that the two Helmholtz coils (450, 460) are driven by direct current or low frequency alternate current, and in that they are used:

10 - To supply a suitable static magnetic field polarization and, when necessary, an appropriate Zeeman modulation to detect Electron Spin Resonance (ESR) in non-authorized substances with unpaired electrons;

15 - To supply a suitable static magnetic field polarization and, when necessary, an appropriate Zeeman modulation to detect Nuclear Magnetic Resonance (NMR) in hydrogen protons;

- To supply an appropriate Zeeman modulation to modulate Nuclear Quadrupole Resonances (NQR) in the substances preferentially detected with this principle.

20 6. A device according to claim 3 or 4 or 5, characterized by the fact that the two Helmholtz coils (450, 460) are partially embedded inside the supporting base (100).

25 7. A device according to any one of claims 3 to 6, characterized by the fact that the axis of the Helmholtz coils (450, 460) are shifted about 10 to 20 mm over the top surface (102) of the supporting base (100) such that the center of mass of the shoe content and the axis of the Helmholtz coils are situated on the same horizontal  
30 plane.

8. A device according to any one of claims 4 to 7, characterized by the fact that the Helmholtz coils (450, 460) are equals (symmetric) and connected in series, in  
35 order to be supplied exactly with the same current.

9. A device according to any one of claim 5, characterized by the fact that the coil drivers are current controlled amplifiers in order to ensure the same magnetic generated field, independently from temperature and other environmental variations.

10. A device according to any one of claims 4 to 9, characterized by the fact that each Helmholtz coil (450, 460) is composed by two coils, one main coil with a very high number of turns, driven at low frequency or by a direct current, and a secondary coil having a lower inductance and able to generate a fast magnetic field modulation sweep.

11. A device according to any one of claims 4 to 10, characterized by the fact that the detector means further comprises a shoe-TX/RX RF antenna (430), totally or partially wound around the heel of the shoe or around the whole shape of the shoe, in order to get the maximum coupling with the materials concealed in the heel or in the whole shape of the shoe.

12. A device according to claim 11, characterized by the fact that the coil of the shoe-TX/RX RF antenna (430) generates a field which is orthogonal or largely orthogonal to the magnetic polarizing field generated by the Helmholtz coils (450, 460).

13 A device according to claim 11 or 12, characterized by the fact that the coil of the shoe-TX/RX RF antenna (430) is a single coil, and acts as transmitter and receiver at the same time.

14 A device according to claim 11 or 12, characterized by the fact that the coil of the shoe-TX/RX RF antenna (430) is divided in at least two or more sections, one or more receivers and one or more emitters, preferentially placed

in a way that the mutual inductive coupling between them is minimum.

15. A device according to any one of claims 11 to 14,  
5 characterized by the fact that the RF shoe-TX/RX antenna (430) is a high-Q inductor.

16. A device according to any one of claims 11 to 15,  
10 characterized by the fact that the coil of the shoe-TX/RX RF antenna (430) connected to a suitable interface network circuit having low RF losses.

17. A device according to any one of claims 4 to 16,  
15 characterized by the fact that the detector means comprise additional RF coils, properly shaped, surrounding the ankle and calf area of the individual being inspected, said additional RF coils being outside of the uniform static magnetic field generated by the Helmholtz coils and, therefore, being used for the  
20 substance detection based on Nuclear Quadrupole Resonance.

18. A device according to any one of claims 1 to 17,  
25 characterized by the fact that it includes means (300) delivering visible or audible messages guiding the user during the successive detection steps.

19. A device according to any one of claims 1 to 18,  
30 characterized by the fact that the detector means further comprise means adapted to detect metal objects.

20. A device according to claim 19, characterized by the  
fact that it further includes two vertical panels (200)  
projecting from the supporting base (100) and housing the  
35 means adapted to detect metal objects.

21. A device according to any one of claims 1 to 20, characterized by the fact that it includes means (800) for picking up vapors or traces of particles, and for analyzing said vapors or traces.

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22. A device according to claim 21, characterized by the fact that the means for picking up vapors or traces comprise suction nozzles (800) on the supporting base (100) and on the vertical panels for picking up vapors or  
10 traces of particles.

23. A device according to claim 21, characterized by the fact that the vertical panels (200) possesses suction nozzles (800) for picking up vapors or traces of  
15 particles.

24. A device according to any one of claims 1 to 23, characterized by the fact that at least one of the vertical panels includes means (612) for displaying the  
20 height at which a prohibited object has been detected.